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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
NEWMAN, MICHAEL A	

ART UNIT	PAPER NUMBER
2624	

MAIL DATE	DELIVERY MODE
12/09/2009	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/595,357	MCNUTT ET AL.	
	Examiner	Art Unit	
	MICHAEL A. NEWMAN	2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 August 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-4,6,7,9,10,12,14,15 and 17-23* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4,6,7,9,10,12,14,15 and 17-23* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *12 April 2006* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. The amendment filed on August 21st, 2009 has been entered.

2. In view of the amendment to the claims, the amendment of claims 1 - 4, 6, 7, 9, 12, 14, 15, 17 – 19; the cancellation of claims 8, 12, 13, 16; and the addition of claims 22 and 23 have been acknowledged. Claim 11 was previously cancelled.

3. In view of the cancellation of claims 8, 12, 13 and 16, the rejections of the claims under 35 U.S.C. 112 2nd paragraph and 35 U.S.C. 103 have been withdrawn.

4. In view of the amendments to claims 1 and 17, the rejection of claims 1 - 7, 9, 10 and 14 – 19 under 35 U.S.C. 112 2nd paragraph has been withdrawn.

5. In view of the amendment to claim 1, the rejection of claims 1 and 14 under 35 U.S.C. 102 has been withdrawn.

6. In view of the amendment to claim 1, the objection to claims 1, 3, 4, 12 and 17 due to minor informalities has been withdrawn.

Response to Arguments

7. Applicant's arguments with respect to claims 1 and 17 have been considered but are moot in view of the new ground(s) of rejection.

   a. In pages 10 – 12 of the Remarks filed on August 21st 2009, regarding the 35 U.S.C. 102 rejection of the independent claim 1 over Krause et al. (U.S. Patent No. 6,701,174), "Krause", and the 35 U.S.C. 103 rejection of previously-dependent claim 17 over Krause and Gauthier (U.S. Pg Pub No. 2004/0012641),

“Gauthier”; Applicant's Representative submits that Krause fails to teach several newly added limitations. Specifically, Applicant’s Representative submits that Krause does not teach (1) acquiring image data of an organ and reconstructing the image into a three-dimensional image representation of the organ, and (2) best fitting a selected model to the three-dimensional image representation and using manual tools for modifying regions of the model to precisely match the model to the three dimensional image representation. As correctly noted by Applicant’s Representative, Krause is interested in creating a deformable detailed 3D model of an organ (e.g. a bone) based on two or more 2D X-ray images obtained at various angles. As part of the process, Krause detects contour on the 2D X-ray images and automatically searches for a similar 3D template bone model stored in a 3D template geometry database, based on the contour. In the new 35 U.S.C. 103 rejection set forth below, the newly found prior art has been introduced to teach that it was well known in the art at the time of the invention to obtain a 3D image representation of an organ using two or more X-rays, and that it was well known that performing recognition of three-dimensional objects, by applying 3D deformable models directly on 3D image volumes, resulted in more robust results. Finally, the newly found prior art teaches that it was well known in the field of medical image interpretation that interactive or semi-automatic techniques, where an expert operator performs some of the more complex steps, are sometimes preferred in applications where erroneous interpretations are unacceptable. Given these teachings, it would

have been obvious to one of ordinary skill in the art at the time the invention was made to allow a user to manually select and manipulate the 3D template models in Krause, so as to best match the 3D volume images obtained from Krause's X-ray images.

8. Applicant's arguments with respect to claim 20 have been fully considered but they are not persuasive.

a. In pages 12 – 13 of the Remarks, regarding the 35 U.S.C. 103 rejection of claim 20 under Krause and Chaney et al. (U.S. Patent No. 5,926,568), "Chaney"; Applicant's Representative submits that the combination fails to teach modifying and fitting a shape model to conform to image data using manual shape altering tools. The Examiner *respectfully* disagrees. As pointed out in the previous Office Action, Krause defines the template bone model in a 3D lattice which is subjected to a free-form deformation process so as to optimally match the patient's bone. Krause incorporates by reference the teachings of A. H. Barr and S. Coquillart, and describes how the deformations allow the user to treat a solid as if it were constructed from special type of topological putty or clay which may be bent, twisted, tapered, compressed, expanded, and otherwise transformed repeatedly into a final shape. Clearly, Krause teaches using manual shape altering tools (bent, twisted, tapered, etc) to modify and fit the shape model to conform to the image data, as required by the claim.

Claim Rejections - 35 USC § 103

9. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

10. Claims 1 – 3, 12, 14, 15 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Krause et al. (U.S. Patent No. 6,701,174), in view of Schweikard et al. (PCT Pub No. WO02/09611) [with reference to its corresponding U.S. Patent No. 7,167,738, as an English translation], McInerney et al. "Deformable Models in Medical Image Analysis." *Medical Image Analysis.* 1.2 (1996): 91-108. Print., Newell et al. (U.S. Patent No. 6,911,980) and Gauthier (U.S. Pg Pub No. 2004/0012641). Hereinafter referred to as Krause, Schweikard, McInerney, Newell and Gauthier, respectively.

a. Regarding claims 1, 2, 3, 14, 15 and 17, Krause teaches a diagnostic imaging system comprising: a scanner for acquiring image data of an organ **(Krause Col. 9 line 66 – Col. 10 line 1)**; a workstation including a memory which stores a plurality of 3D shape models and one or more processors which define a set of global tools and a set of manual tools **(Krause Fig. 2 element 30, Col. 8 lines 13 – 52 and Fig. 3 element 50, Col. 12 lines 5 – 8)**. Krause detects contour on the 2D X-ray images and automatically searches for a similar 3D template bone model stored in a 3D template geometry database, based on the contour. Krause **fails to teach** a reconstruction processor for reconstruction the image data into a three dimensional (3D) image representation of the organ. **Pertaining to the same field of endeavor, Schweikard teaches a similar**

three-dimensional visualization system in which two or more X-ray images are used by a computer to generate a 3D representation of the femur bone (Schweikard Col. 6 lines 42 – 64). Also pertaining to the same field of endeavor, McInerney teaches that more robust 3D models representing 3D objects can be obtained, in less time, by applying 3D deformable models directly on 3D image volumes instead of slice by slice using 2D contour models (McInerney Pg 8 – Section 3.2). Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to generate the volumetric image of the bone captured by Krause's two or more X-ray images, and to perform any subsequent 3D deformable model fitting on that volume directly instead of on separate 2D contours, so as to avoid the post-processing steps required to connect sequences of 2D contours into a continuous surface and to avoid the inconsistencies, ring, or band defects (McInerney Page 8 – Section 3.2) As previously discussed, Krause further teaches storing 3D template bone models in a database and automatically selecting the ones closest to the bones in the input images. Krause then refines an initial closed volume 3D bone representation by automatically finding a 3D template bone model that fits in the volume and resembles the bone image contours **(Krause Col. 12 lines 4 – 24)**. The 3D template model is positioned and scaled so as to optimally match that of the patient's bone's image **(Krause Col. 12 lines 24 – 29)**. Krause also teaches that the 3D templates are in the form of a 3D lattice allowing free-form deformation so

as to optimally match them with the contours of the patient's bone **(Krause Col. 12 lines 42 – 46)**. More specifically, that the deformations "allow the user to treat a solid as if it were constructed from a special type of putty or clay which may be bent, twisted, tapered, compressed, expanded or otherwise transformed repeatedly in to a final shape" **(Krause Col. 12 line 64 – Col. 13 line 5)**. Finally, Krause also teaches a graphical user interface in which the 3D models can be interacted-with by a surgeon using a pointing device such as a computer mouse **(Krause Col. 19 lines 38 – 45)**. Krause; however, **does not specifically teach** that the user interface is one by which a user: selects a 3D shape model of the organ from the workstation memory; manipulates the set of global tools to fit the selected 3D shape model to the 3D image representation of the organ; and manipulates the set of manual tools to modify selected regions of the selected 3D shape model to match corresponding regions of the 3D image representation of the organ. **McInerney, that although automatic interpretation of medical images is a desirable goal, interactive/semiautomatic techniques in which an expert operator manually performs certain tasks is preferred in applications where erroneous interpretations are unacceptable (McInerney - Page 16 Section 4.1). Pertaining to the same field of endeavor, Newell teaches a surface manipulation interface allowing a user to select and drag a point on the curve (Newell Col. 2 lines 64 – 67). Specifically, the user will click and drag the mouse from one point to another to trigger a flexible sheet illusion (Newell Col. 3 lines 1 – 8) while causing the vertices to move**

accordingly (Newell – Fig. 9). In a specifically pertinent embodiment, Newell teaches that when it is useful to produce symmetric or pre-defined distortions, the mouse movement in vertical and horizontal directions can be converted into the magnitudes of such distortions (Newell Col. 6 lines 44 – 66 and Col. 8 lines 11 – 16). <u>Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to enable a user to virtually manipulate the 3D model in Krause so as to more closely fit it to the topology of the reconstructed 3D organ image, by converting mouse movements directly into distortion parameters, as taught by Newell, in order to provide an easy to learn and natural user interface (Newell Col. 2 lines 64 – 65) in which the 3D model surface vertices can be pulled/pushed by mouse movements and thus resemble a topological putty or clay, as suggested by Krause.</u> Also pertaining to the same field of endeavor, Gauthier teaches a three-dimensional image generation system in which a user can select a three-dimensional component from an 'icon area' containing the available components drag and drop it onto a virtual surface for further manipulation (Gauthier PPs 0049 – 0052 and Figs. 7 and 8). <u>Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to allow the surgeon/operator, having already determined which of the patient's anatomical parts is being evaluated, to manually select the most representative 3D template model on a database list by quickly dragging and dropping the 3D template model</u>

onto the image surface, thus avoiding the computational complexity required to make the automatic determination while providing an intuitive, minimally-cumbersome user interface for the operator.

b. Regarding claim 12, Krause further teaches the system as set forth in claim 3, wherein the manual tools include: a pencil tool which deforms an original boundary of the selected 3D model to align the original boundary with a drawing path defined by a mouse **(Krause Col. 11 lines 19 – 21 and lines 62 – 67)**.

11. Claims 4 – 10, 18 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Krause et al. (U.S. Patent No. 6,701,174), in view of Schweikard et al. (PCT Pub No. WO02/09611) [with reference to its corresponding U.S. Patent No. 7,167,738, as an English translation], McInerney et al. "Deformable Models in Medical Image Analysis." *Medical Image Analysis.* 1.2 (1996): 91-108. Print., Newell et al. (U.S. Patent No. 6,911,980) and Gauthier (U.S. Pg Pub No. 2004/0012641) as applied to claim 3 above, and further in view of Ohba (U.S. Patent No. 4,885,702). Hereinafter referred to as Krause, Schweikard, McInerney, Newell, Gauthier and Ohba, respectively.

a. Regarding claims 4, 5, 6, 7, 9 and 10, Krause, Schweikard, McInerney, Newell and Gauthier teach all the limitations of the dependent claim 3 as set forth in the 35 U.S.C. 103 rejection of claim 3 above. As previously discussed, Newell teaches converting a mouse dragging movement directly into parameters of pre-defined surface distortions. However, **neither Krause or Newell teach** a Gaussian pull tool which deforms a surface of the model by pulling selected

vertices along a predefined smooth curve, wherein the predefined smooth curve is a Gaussian curve, wherein the Gaussian curve is controlled by a radius which defines a width of Gaussian spread and wherein the Gaussian curve is controlled by x- and y-radii, wherein x-radius defines a width of Gaussian spread in a direction of a move of a mouse and y-radius defines a width of Gaussian spread in a direction which is orthogonal to the mouse move. **Pertaining to the same field of endeavor Ohba teaches a surface deformation providing a user interface enabling a user to select from and control the amount of a set of predefined surface distortion functions, and see the results in real time (Ohba Col. 6 lines 56 – 62). Specifically, Ohba teaches the application of a gradual and symmetric Gaussian (or spherical) distribution function to obtain a deformed surface in which the deformation quantity has a maximum value at the center/action point and converges gradually to zero as the displacement from the center increases (Ohba Col. 5 lines 55 – 64 – Fig. 3 & Col. 15 lines 3 – 33 – Fig. 11). Ohba teaches that using a Gaussian distribution deformation results in a soft and natural curved surface (Ohba Col. 8 lines 3 – 6). To apply the deformation, the user uses a mouse to select the action point (or center), two levers to control the x and y-direction diameters and a third lever to control the height of the Gaussian deformation (Ohba Col. 8 lines 22 – 39). <u>Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to restrict user manipulations of Krause's models to gradual and</u>**

natural deformations, such as the Gaussian distribution deformations taught by Ohba, by converting mouse movements in the vertical and horizontal directions directly into the distribution's x and y-direction radii, as taught by Newell, so as to replace Ohba's levers (as motivated by Newell in Col. 6 lines 55 – 57), thus providing an intuitive mouse-only user interface while ensuring the resulting 3D models appear natural and realistic.

b. Regarding claim 8, Krause as modified by Schweikard, McInerney, Newell, Gauthier and Ohba with regards to claim 5 teaches that the Gaussian curve is controlled by a function which smoothly transitions from 1 to 0 **(Ohba Fig. 3 – Col. 5 lines 55 – 65) [Note that the figure and discussion, which teach a Gaussian distribution distortion function which gradually varies from a deformation vector height to zero, are directed to the resulting deformation given by equation 1 (Col. 5). However, it is clear that the controlling function in equation 1 is actually a Gaussian function with unity gain, F_i, multiplied by the vector height, V_i].**

c. Regarding claims 18 and 19, Krause as modified by Schweikard, McInerney, Newell and Gauthier teach all the limitations of the dependent claim 17, as set forth in the 35 U.S.C. 103 rejection of claim 17 above. As previously discussed, Krause teaches that the model is represented by an adaptive mesh which includes vertices and links connecting individual vertices **(Krause Col. 12 lines 42 – 53 and Fig. 9A and 9B)**. Krause also teaches the use of a computer

mouse to manipulate the 3D models **(Krause Col. 19 lines 41 – 43)**. However, **Krause does not explicitly teach** that the step of deforming includes: selecting vertices to be deformed; and deforming them in accordance with a move of a mouse. **Pertaining to the same field of endeavor, Newell teaches a surface manipulation interface allowing a user to select and drag a point on the curve (Newell Col. 2 lines 64 – 67). Specifically, the user will click and drag the mouse from one point to another to trigger a flexible sheet illusion (Newell Col. 3 lines 1 – 8) while causing the vertices to move accordingly (Newell – Fig. 9). In a specifically pertinent embodiment, Newell teaches that when it is useful to produce symmetric or pre-defined distortions, the mouse movement in vertical and horizontal directions can be converted into the magnitudes of such distortions (Newell Col. 6 lines 44 – 66 and Col. 8 lines 11 – 16). <u>Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to enable a user to virtually manipulate the 3D model in Krause, by converting mouse movements directly into distortion parameters, as taught by Newell, in order to provide an easy to learn and natural user interface (Newell Col. 2 lines 64 – 65) in which the 3D model surface vertices can be pulled/pushed by mouse movements and thus resemble a topological putty or clay, as suggested by Krause.</u>** However, Krause and Newell still **fail to teach** selecting a transformation algorithm to transform the vertices; converting the mouse motion into local deformation parameters; and transforming the selected vertices

in the model by the local deformation parameters. **Pertaining to the same field of endeavor Ohba teaches a surface deformation providing a user interface enabling a user to select from and control the amount of a set of predefined surface distortion functions, and see the results in real time (Ohba Col. 6 lines 56 – 62). Specifically, Ohba teaches the application of a gradual and symmetric Gaussian (or spherical) distribution function to obtain a deformed surface in which the deformation quantity has a maximum value at the center/action point and converges gradually to zero as the displacement from the center increases (Ohba Col. 5 lines 55 – 64 – Fig. 3 & Col. 15 lines 3 – 33 – Fig. 11). Ohba teaches that using a Gaussian distribution deformation results in a soft and natural curved surface (Ohba Col. 8 lines 3 – 6). To apply the deformation, the user uses a mouse to select the action point (or center), two levers to control the x and y-direction diameters and a third lever to control the height of the Gaussian deformation (Ohba Col. 8 lines 22 – 39). <u>Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to restrict user manipulations of Krause's models to gradual and natural deformations, such as the Gaussian distribution deformations taught by Ohba, by converting mouse movements in the vertical and horizontal directions directly into the distribution's x and y-direction radii, as taught by Newell, so as to replace Ohba's levers (as motivated by Newell in Col. 6 lines 55 – 57), thus providing an intuitive mouse-only user</u>**

<u>interface while ensuring the resulting 3D models appear natural and realistic.</u>

12. Claims 20 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Krause et al. (U.S. Patent No. 6,701,174) in view of Chaney et al. (U.S. Patent No. 5,926,568). Hereinafter referred to as Krause and Chaney respectively.

a. Regarding claim 20, Krause teaches a method preparing a therapy plan comprising: acquiring image data **(Krause Col. 9 line 66 to Col. 10 line 1)**; automatically segmenting the image data by selecting a best-fit model representative of one or more segmented structures in the image data **(Col. 12 lines 21 – 29) [Note that the template is initialed by being positioned and scaled so as to resemble the patient's bone]**; applying manual shape-altering tools to the best-fit model such as to modify the model to conform to the image data **(Col. 12 lines 42 – 46 and Col. 12 line 66 to Col. 13 line 15) [Krause incorporates by reference the teachings of A. H. Barr and S. Coquillart, and describes how the deformations allow the user to treat a solid as if it were constructed from special type of topological putty or clay which may be bent, twisted, tapered, compressed, expanded, and otherwise transformed repeatedly into a final shape. Clearly, Krause teaches using manual shape altering tools (bent, twisted, tapered, etc) to modify and fit the shape model to conform to the image data]**. Krause further teaches that the resulting realistic 3D models can assist a surgeon in making detailed surgical plans

(Krause Col. 17 lines 44 – 51), and can be useful for determining treatment deviation or progress by comparing saved pre-treatment models with corresponding post-treatment models **(Krause Col. 20 lines 1 – 13)**. However, Krause is mainly concerned with bone treatment and **does not explicitly teach** the use of the 3D models to form a radiation therapy plan. **Pertaining to the same field of endeavor, Chaney teaches an automatic anatomical part recognition system tolerant to shape and image variations (Chaney Col. 3 lines 32 – 35). Not unlike Krause, Chaney first acquires an image of the body organ and selects a shape template model of the particular organ and initializes it by performing global transformations (translation, rotation, scaling) (Chaney Col. 7 line 33 – Col. 8 line 6). Chaney then performs semi-automatic local deformation of the template model to minimize the error (Chaney Col. 8 lines 18 – 36). Chaney teaches a correctly segmented organ model, showing the correct size, shape and location, is useful for physicians practicing radiation therapy by allowing them to carefully direct radiation into the predetermined treatment area while avoiding surrounding tissue (Chaney Col. 1 lines 19 – 46). Furthermore, Chaney teaches that in some cases, X-ray planning images of the affected regions are manually reviewed by the physician to determine the most appropriate radiation treatment approach (Chaney Col. 1 line 66 – Col. 2 line 8). <u>Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the 3D organ model, obtained by Krause from X-</u>**

<u>ray images, to accurately measure the dimensions and location of the organ and use them to determine the appropriate radiation therapy beam direction and intensity, as taught by Chaney, to maximize effectiveness while minimizing peripheral tissue radiation damage.</u>

b. Regarding claim 21, Krause, as modified by Chaney, further teaches that the modified model is saved as a potential best-fit model in future radiation therapy plans **(Krause Col. 12 lines 35 – 41)**.

13. Claims 22 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Krause et al. (U.S. Patent No. 6,701,174), in view of Chaney et al. (U.S. Patent No. 5,926,568), as applied to claim 20 above, and further in view of Schweikard et al. (PCT Pub No. WO02/09611) [with reference to its corresponding U.S. Patent No. 7,167,738, as an English translation], McInerney et al. "Deformable Models in Medical Image Analysis." *Medical Image Analysis*. 1.2 (1996): 91-108. Print., Newell et al. (U.S. Patent No. 6,911,980) and Ohba (U.S. Patent No. 4,885,702). Hereinafter referred to as Krause, Chaney, Schweikard, McInerney, Newell and Ohba, respectively.

Regarding claims 22 and 23, Krause as modified by Chaney teaches all the limitations of the independent claim 20 as set forth in the 35 U.S.C. 103 rejection of claim 20 above. As previously discussed, Krause detects contour on the 2D X-ray images and automatically searches for a similar 3D template bone model stored in a 3D template geometry database, based on the contour. However, Krause **fails to teach** that the image data is a three dimensional image

representation of an object. **Pertaining to the same field of endeavor, Schweikard teaches a similar three-dimensional visualization system in which two or more X-ray images are used by a computer to generate a 3D representation of the femur bone (Schweikard Col. 6 lines 42 – 64). Also pertaining to the same field of endeavor, McInerney teaches that more robust 3D models representing 3D objects can be obtained, in less time, by applying 3D deformable models directly on 3D image volumes instead of slice by slice using 2D contour models (McInerney Pg 8 – Section 3.2). <u>Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to generate the volumetric image of the bone captured by Krause's two or more X-ray images, and to perform any subsequent 3D deformable model fitting on that volume directly instead of on separate 2D contours, so as to avoid the post-processing steps required to connect sequences of 2D contours into a continuous surface and to avoid the inconsistencies, ring, or band defects (McInerney Page 8 – Section 3.2)</u>** As previously discussed, Krause teaches that the model is represented by an adaptive mesh which includes vertices and links connecting individual vertices **(Krause Col. 12 lines 42 – 53 and Fig. 9A and 9B)**. Krause also teaches the use of a computer mouse to manipulate the 3D models **(Krause Col. 19 lines 41 – 43)**. However, **Krause does not explicitly teach** that the step of deforming includes: selecting vertices to be deformed; and deforming them in accordance with a move of a mouse. **Pertaining to the same field of**

endeavor, Newell teaches a surface manipulation interface allowing a user to select and drag a point on the curve (Newell Col. 2 lines 64 – 67). Specifically, the user will click and drag the mouse from one point to another to trigger a flexible sheet illusion (Newell Col. 3 lines 1 – 8) while causing the vertices to move accordingly (Newell – Fig. 9). In a specifically pertinent embodiment, Newell teaches that when it is useful to produce symmetric or pre-defined distortions, the mouse movement in vertical and horizontal directions can be converted into the magnitudes of such distortions (Newell Col. 6 lines 44 – 66 and Col. 8 lines 11 – 16). <u>Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to enable a user to virtually manipulate the 3D model in Krause, by converting mouse movements directly into distortion parameters, as taught by Newell, in order to provide an easy to learn and natural user interface (Newell Col. 2 lines 64 – 65) in which the 3D model surface vertices can be pulled/pushed by mouse movements and thus resemble a topological putty or clay, as suggested by Krause.</u> However, Krause and Newell still **fail to teach** selecting a transformation algorithm to transform the vertices; converting the mouse motion into local deformation parameters; and transforming the selected vertices in the model by the local deformation parameters. **Pertaining to the same field of endeavor Ohba teaches a surface deformation providing a user interface enabling a user to select from and control the amount of a set of predefined surface distortion**

functions, and see the results in real time (Ohba Col. 6 lines 56 – 62). Specifically, Ohba teaches the application of a gradual and symmetric Gaussian (or spherical) distribution function to obtain a deformed surface in which the deformation quantity has a maximum value at the center/action point and converges gradually to zero as the displacement from the center increases (Ohba Col. 5 lines 55 – 64 – Fig. 3 & Col. 15 lines 3 – 33 – Fig. 11). Ohba teaches that using a Gaussian distribution deformation results in a soft and natural curved surface (Ohba Col. 8 lines 3 – 6). To apply the deformation, the user uses a mouse to select the action point (or center), two levers to control the x and y-direction diameters and a third lever to control the height of the Gaussian deformation (Ohba Col. 8 lines 22 – 39). <u>Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to restrict user manipulations of Krause's models to gradual and natural deformations, such as the Gaussian distribution deformations taught by Ohba, by converting mouse movements in the vertical and horizontal directions directly into the distribution's x and y-direction radii, as taught by Newell, so as to replace Ohba's levers (as motivated by Newell in Col. 6 lines 55 – 57), thus providing an intuitive mouse-only user interface while ensuring the resulting 3D models appear natural and realistic.</u>

Conclusion

14. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

a. Kang, Yan, Klaus Engelke, and Willi Kalender. "Interactive 3D editing tools for image segmentation." *Medical Image Analysis 8*. 8. (2003 (Online)): 35-46.

15. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MICHAEL A. NEWMAN whose telephone number is (571) 270-3016. The examiner can normally be reached on Mon - Thurs from 9:30am to 6:30pm (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bhavesh M. Mehta can be reached on (571) 272-7453. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Bhavesh M Mehta/
Supervisory Patent Examiner, Art Unit 2624

M.A.N.